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Ling et al.

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(54) **IMPELLER**

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(22) Filed: **Dec. 13, 2023**

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

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F04D 17/08	(2006.01)
F04D 19/00	(2006.01)
F04D 29/02	(2006.01)
F04D 29/054	(2006.01)
F04D 29/32	(2006.01)
F04D 29/52	(2006.01)

(52) **U.S. Cl.**

CPC ***F04D 29/263*** (2013.01); ***F04D 17/08*** (2013.01); ***F04D 19/002*** (2013.01); ***F04D 29/023*** (2013.01); ***F04D 29/054*** (2013.01); ***F04D 29/325*** (2013.01); ***F04D 29/522*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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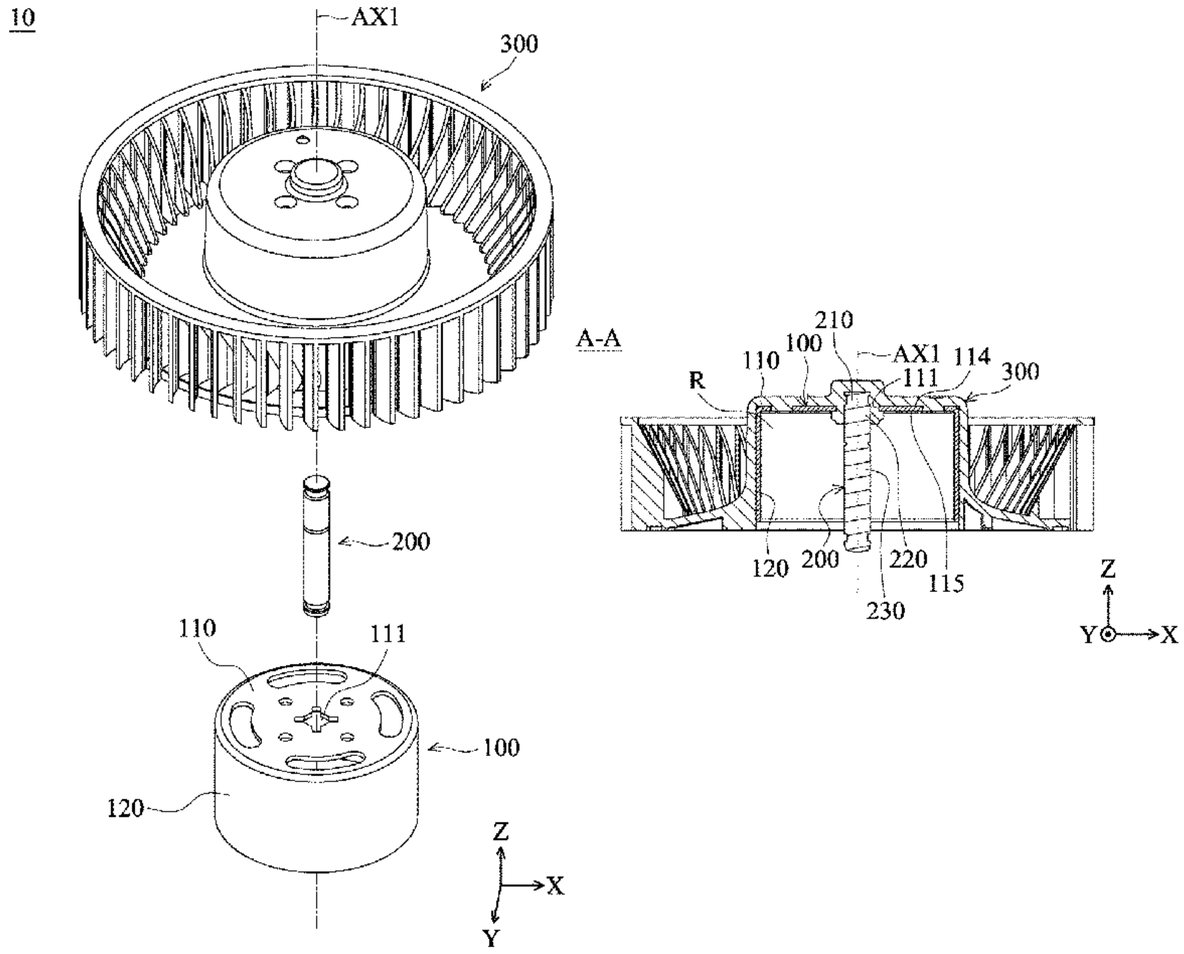
(57) **ABSTRACT**

An impeller is provided, including a metal housing, a shaft, and a plastic member. The metal housing has a shaft mounting hole. The inner surface of the shaft mounting hole includes three or more contact points, and the contact points are closer to the shaft than other portions of the inner surface of the shaft mounting hole. The shaft passes through the shaft mounting hole and is affixed by the contact points. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

17 Claims, 6 Drawing Sheets



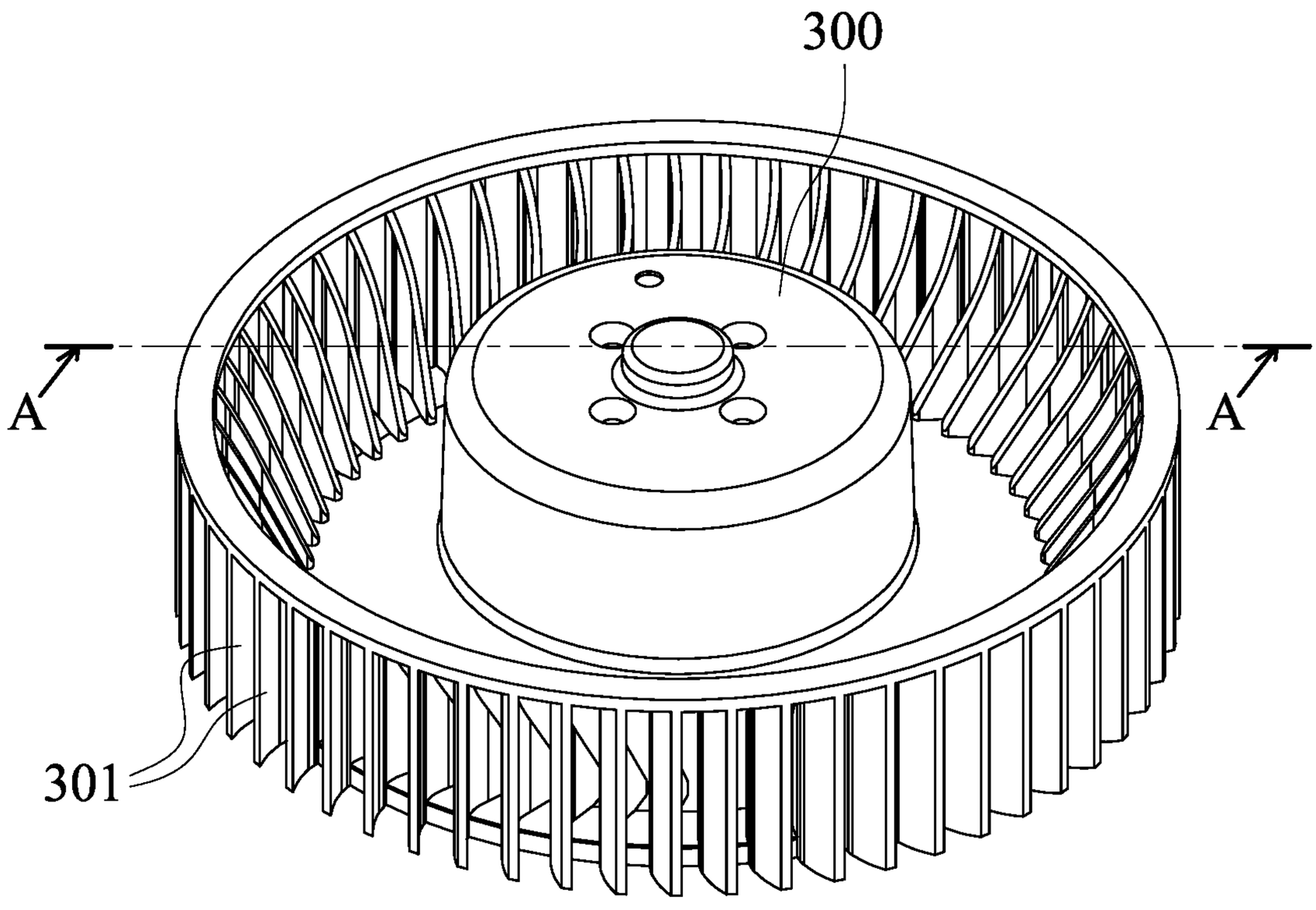


FIG. 1

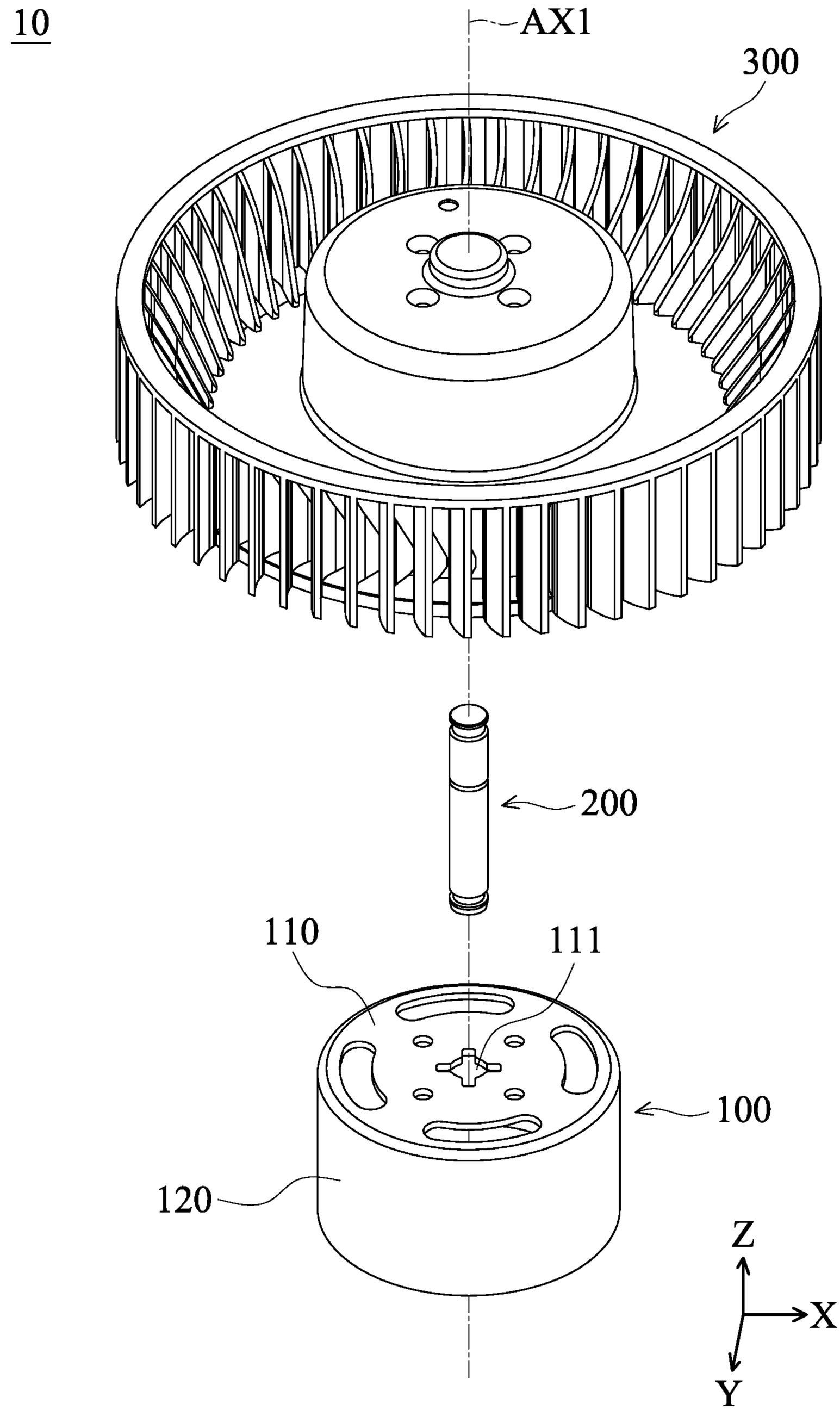


FIG. 2

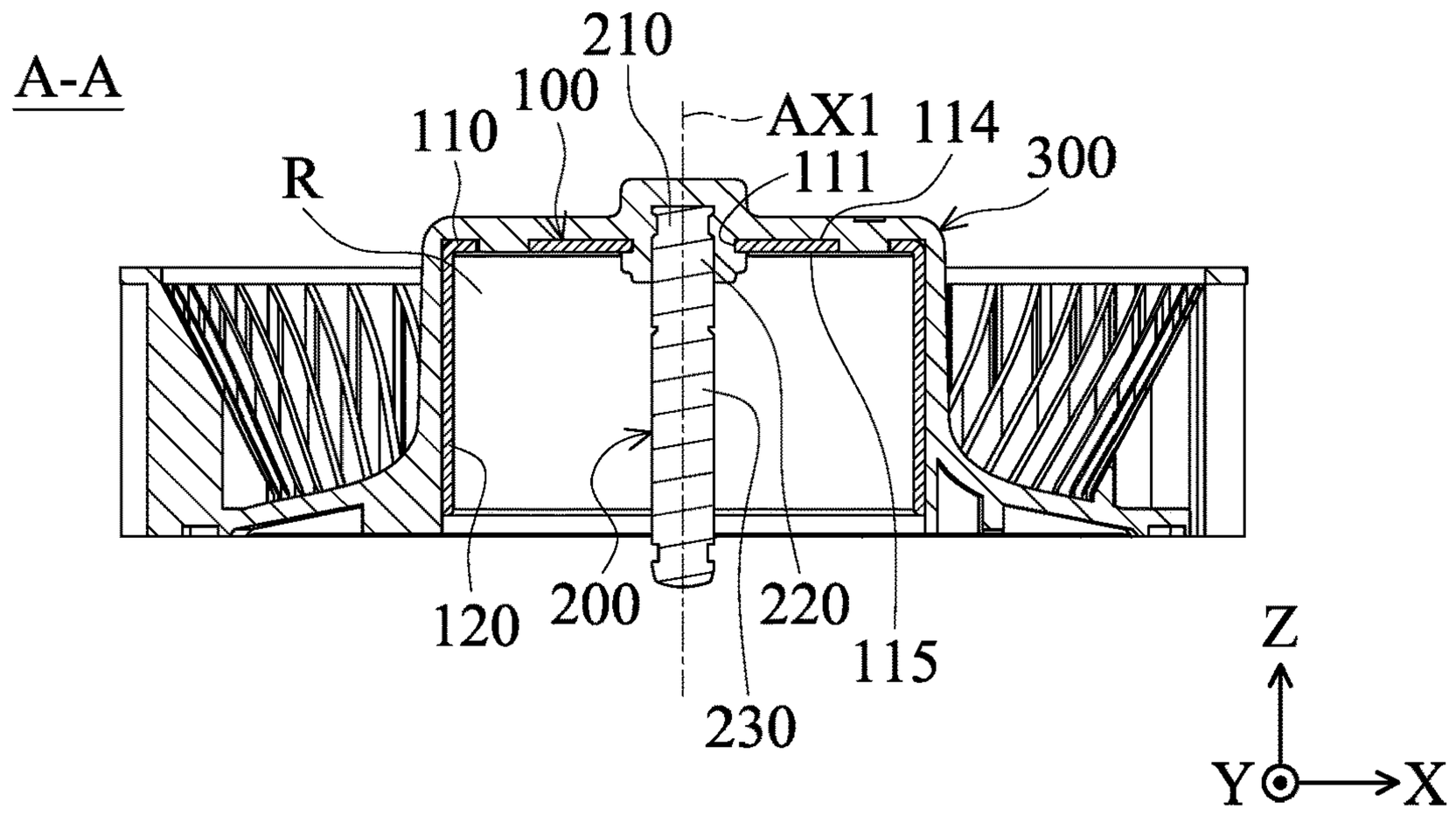

A-A
210
100
110
AX1
114
111
300
R
120
200
220
115
230
Z
Y
X

FIG. 3

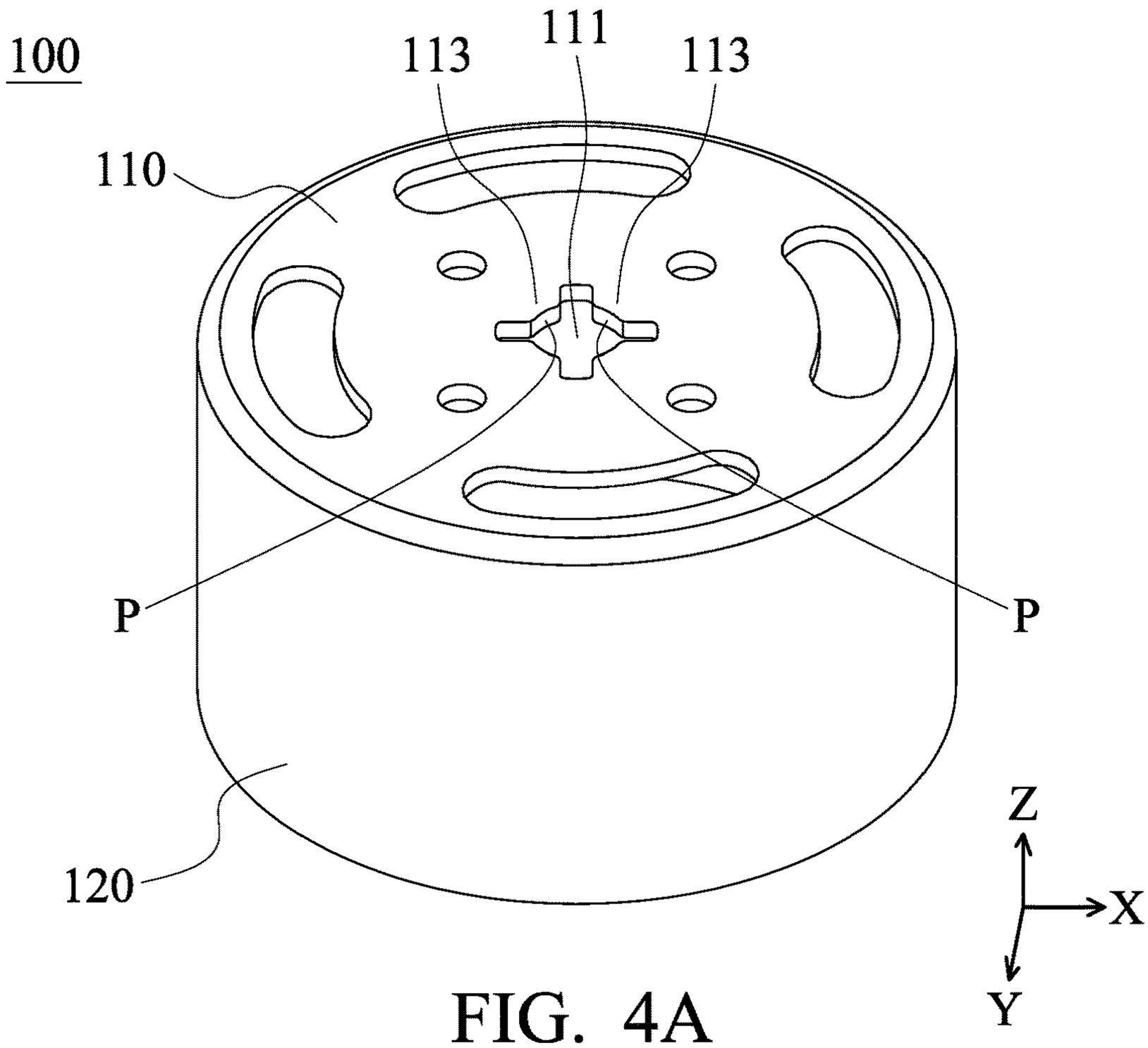

100
113
111
113
110
P
P
120
Z
X
Y

FIG. 4A

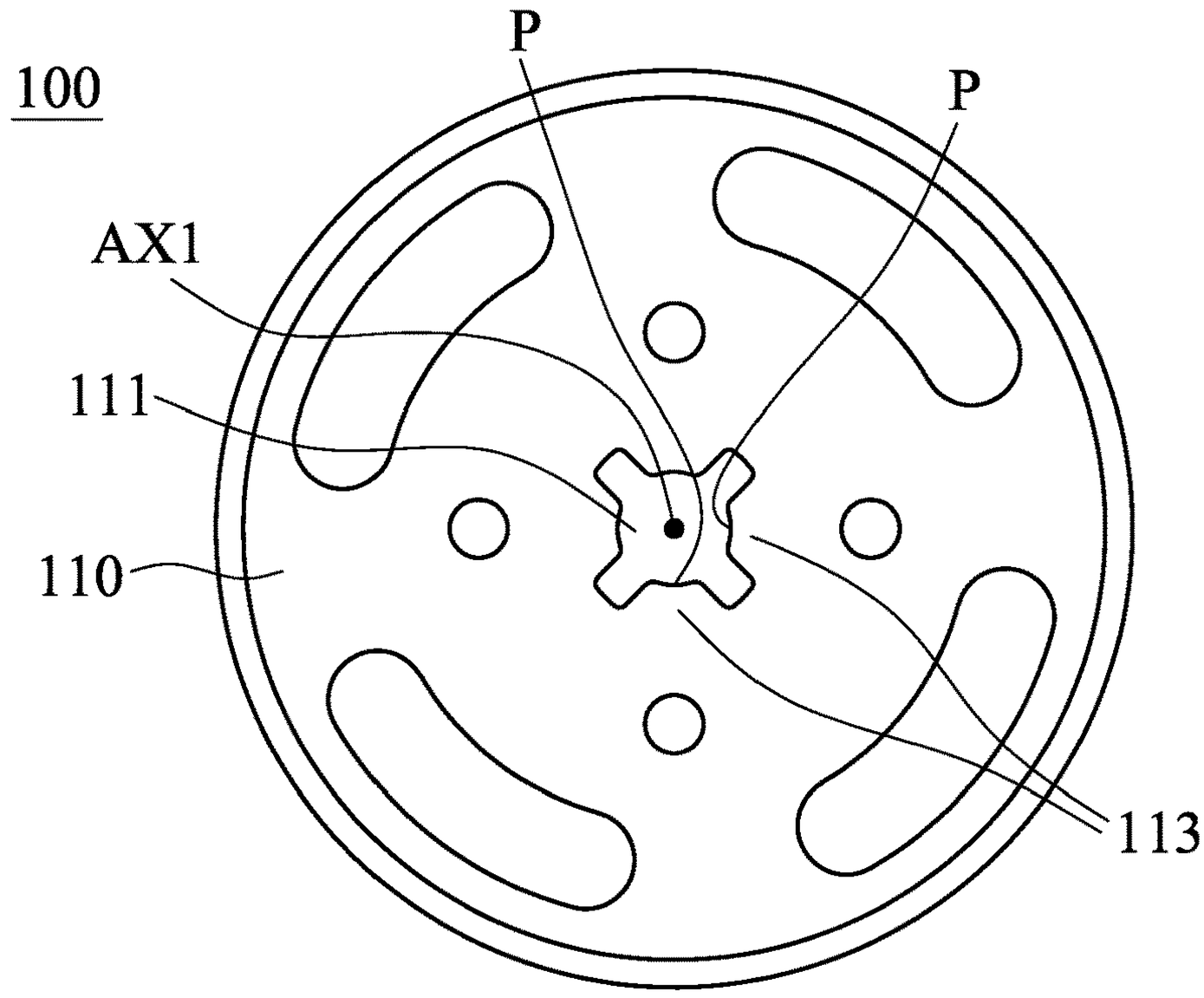


FIG. 4B

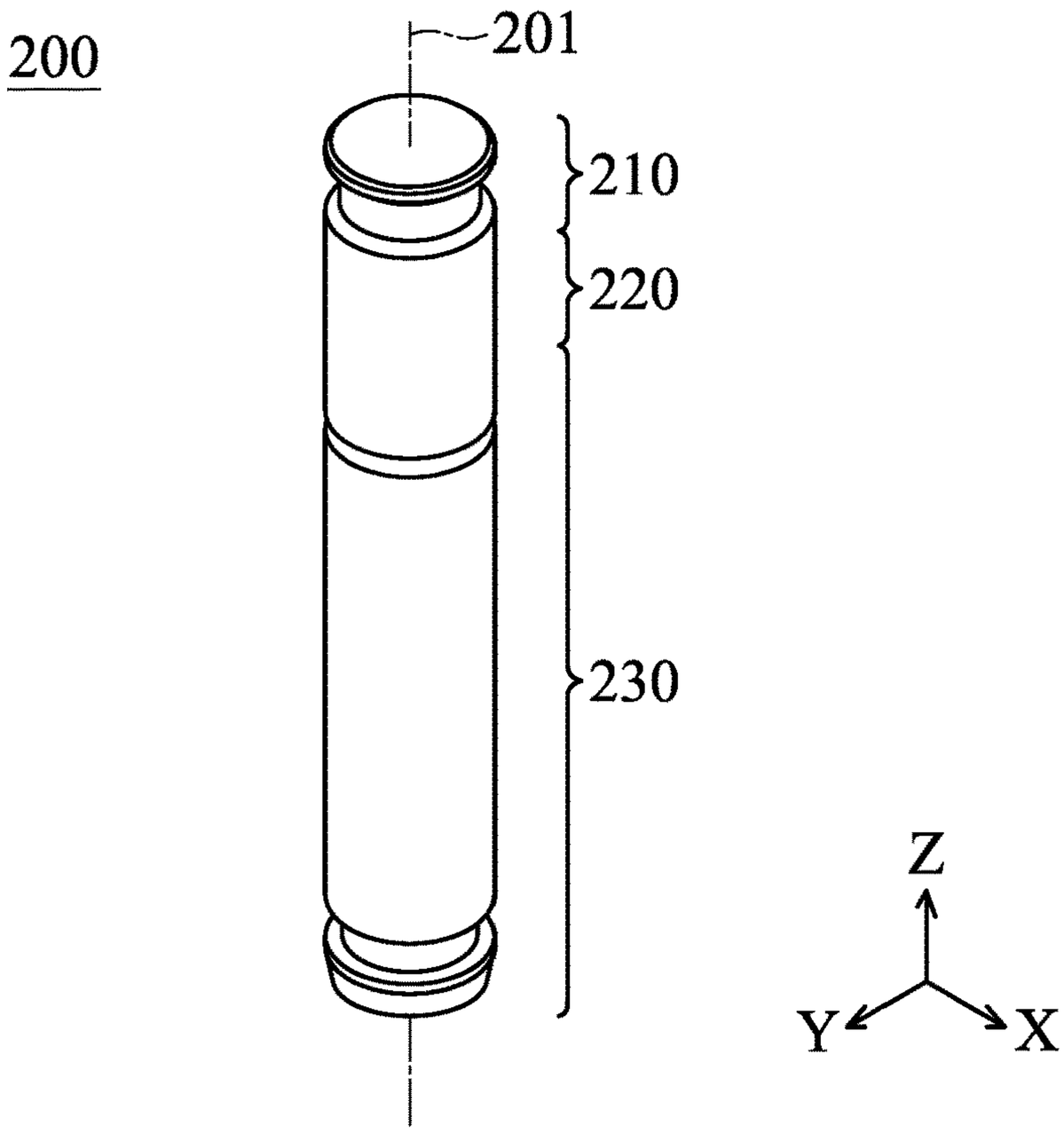


FIG. 5

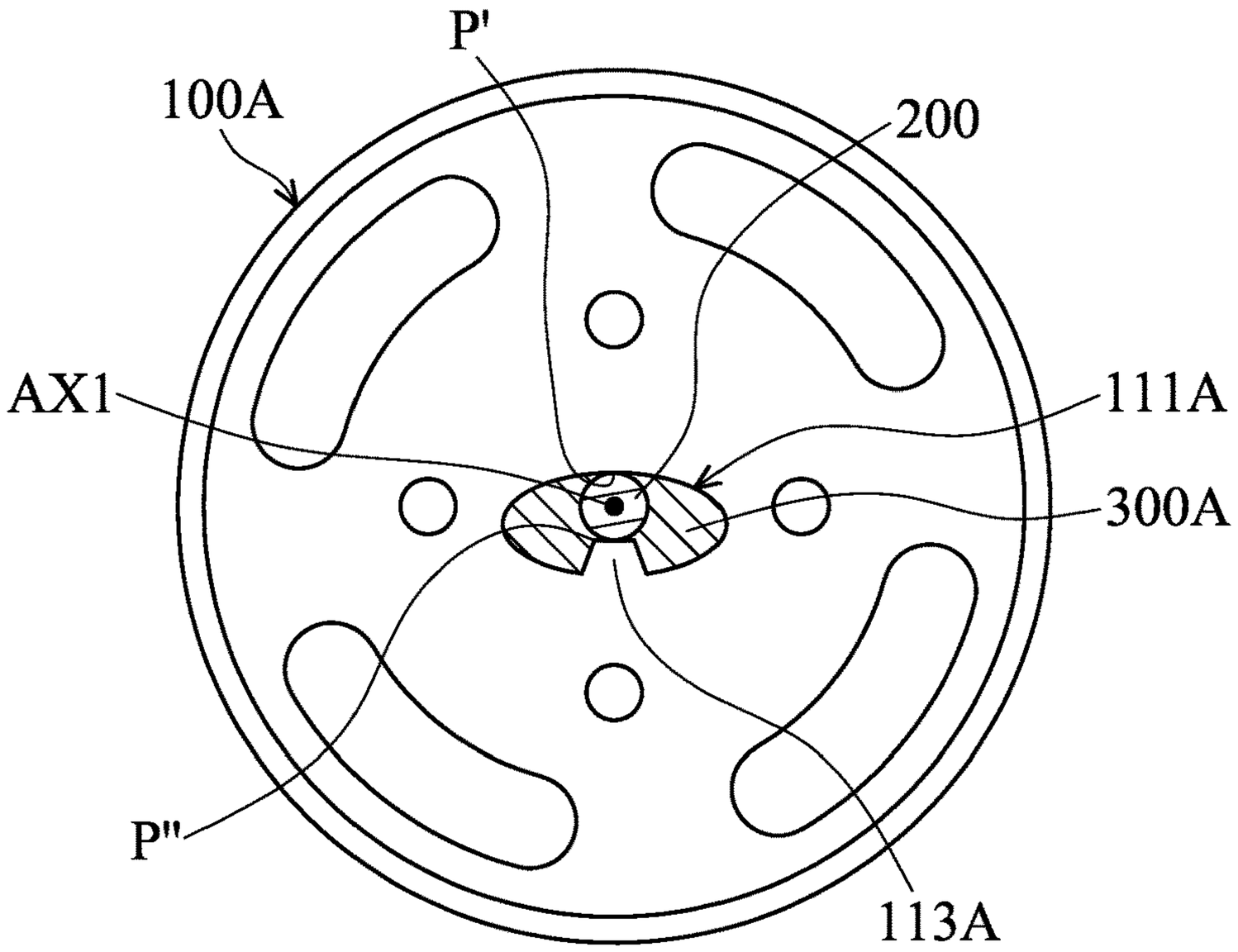


FIG. 6

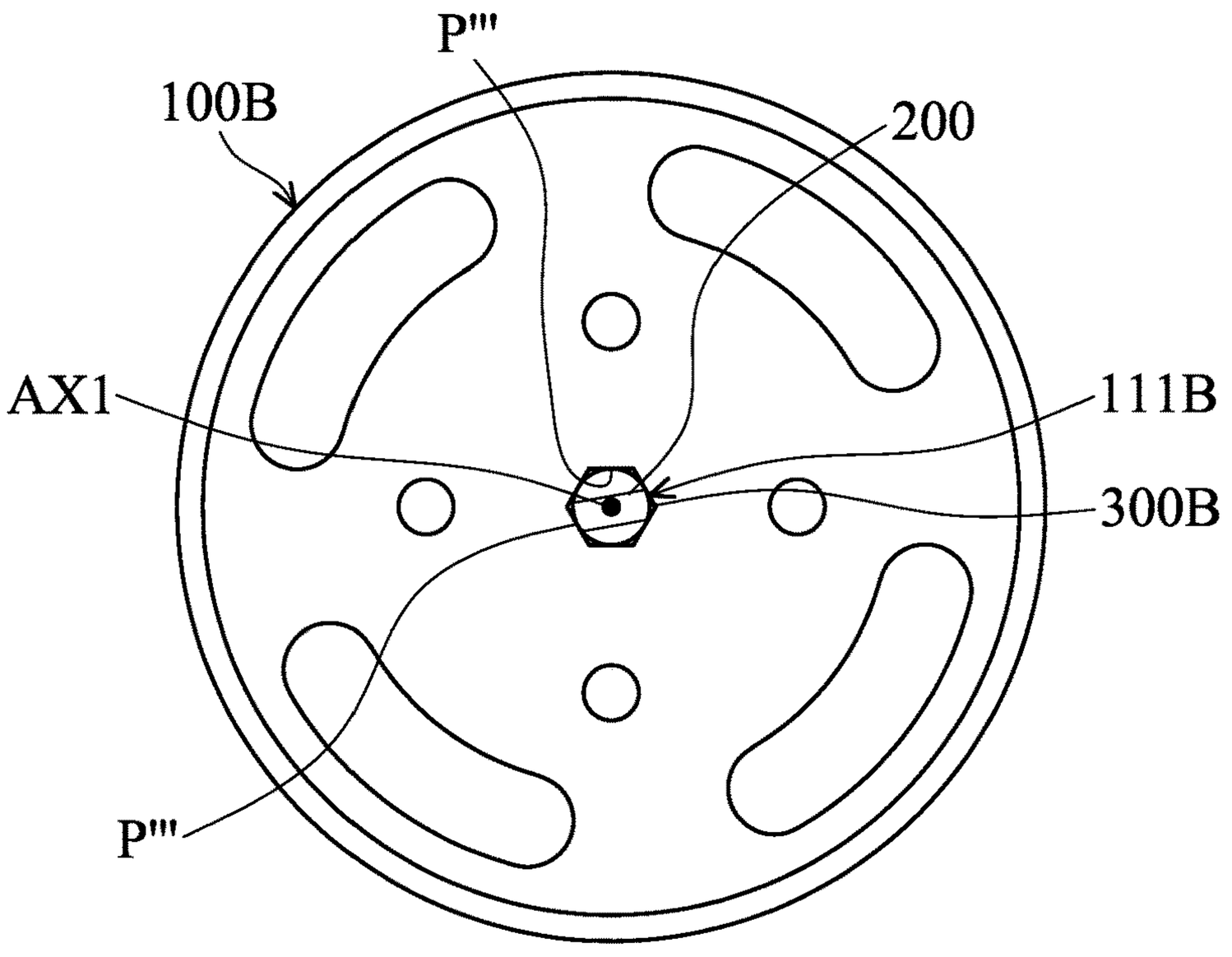


FIG. 7

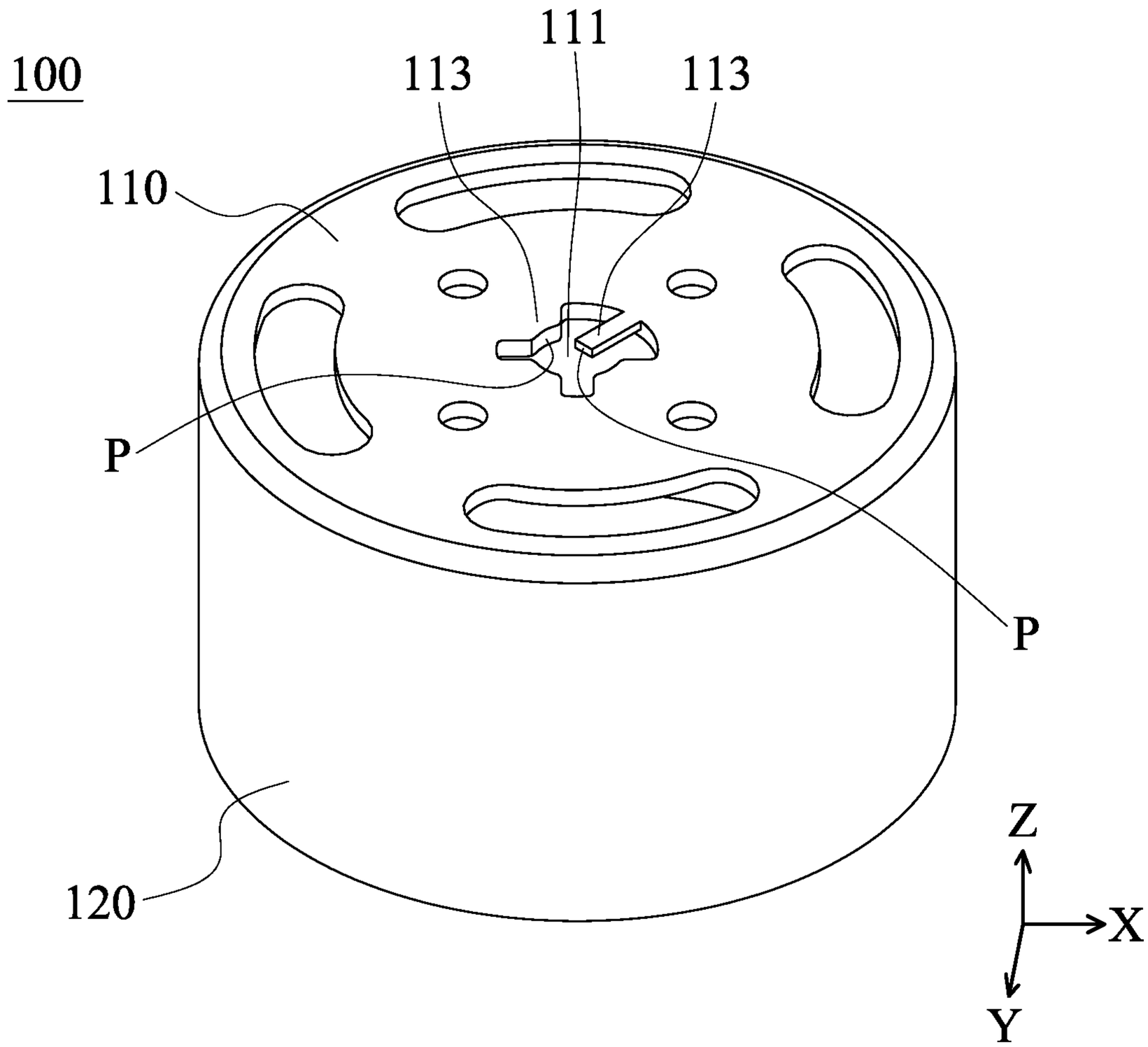


FIG. 8

IMPELLER

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of application Ser. No. 18/184,344, filed Mar. 15, 2023, which is a Continuation of application Ser. No. 17/391,739, filed on Aug. 2, 2021, which claims the benefit of China Patent Application No. 202110181727.4, filed Feb. 9, 2021, the entirety of which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

Field of the Invention

The application relates in general to an impeller, and in particular, to an impeller having a metal housing.

Description of the Related Art

Electronic devices are being developed to provide better performance, be lighter, and have a thinner structure. However, these features can increase the internal operating temperature of the electronic devices, making them unstable and thus affecting their reliability. Therefore, existing electronic devices are usually equipped with a fan to dissipate the generated heat.

Some fans include a metal case for preventing electromagnetic interference. However, connecting the metal case to the shaft can be difficult, and the cost of manufacturing may increase. Therefore, how to address the aforementioned problem has become an important issue.

BRIEF SUMMARY OF INVENTION

To address the deficiencies of conventional products, an embodiment of the invention provides an impeller, including a metal housing, a shaft, and a plastic member. The metal housing has a shaft mounting hole. The inner surface of the shaft mounting hole includes three or more contact points, and the contact points are closer to the shaft than other portions of the inner surface of the shaft mounting hole. The shaft passes through the shaft mounting hole and is affixed by the contact points. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

In some embodiments, the plastic member is in contact with the inner surface. Two or more contact portions are formed on the inner surface, and the contact points are formed on the contact portion. The contact areas, the dimensions, or the shapes of two of the contact portions are different. An embossing texture is formed on the shaft or the inner surface, and at least a portion of the embossing texture is in contact with the plastic member. The plastic member is extended to contact at least a portion of the upper section or a portion of the lower section. The metal housing has an upper surface and a lower surface opposite to the upper surface. The upper section protrudes from the upper surface, and the lower section protrudes from the lower surface. The plastic member is also in contact with the upper surface and the lower surface.

An impeller is also provided, including a metal housing, a shaft, and a plastic member. A contact portion is formed on the inner surface of the shaft mounting hole. The shaft passes through the shaft mounting hole and is affixed by the contact portion. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

In some embodiments, the plastic member is in contact with the inner surface. The opening of the shaft mounting hole is a polygonal opening. An embossing texture is formed on the shaft or the inner surface, and at least a portion of the embossing texture is in contact with the plastic member. The plastic member is extended to contact at least a portion of the upper section or a portion of the lower section. The metal housing has an upper surface and a lower surface opposite to the upper surface. The upper section protrudes from the upper surface, and the lower section protrudes from the lower surface. The plastic member is also in contact with the upper surface and the lower surface. The thickness of the contact portion is less than the thickness of the metal housing at the periphery of the shaft mounting hole.

An impeller is further provided, including a metal housing, a shaft, and a plastic member. The metal housing has a shaft mounting hole. The opening of the shaft mounting hole is a polygonal opening. The shaft passes through the shaft mounting hole and is affixed by the shaft mounting hole. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

In some embodiments, the plastic member is in contact with the inner surface of the shaft mounting hole. The plastic member is extended to contact at least a portion of the upper section or a portion of the lower section. An embossing texture is formed on the shaft or the inner surface of the shaft mounting hole, and at least a portion of the embossing texture is in contact with the plastic member. The metal housing has an upper surface and a lower surface opposite to the upper surface. The upper section protrudes from the upper surface, and the lower section protrudes from the lower surface. The plastic member is also in contact with the upper surface and the lower surface.

BRIEF DESCRIPTION OF DRAWINGS

The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

FIG. **1** is a schematic diagram of an impeller according to an embodiment of the invention;

FIG. **2** is an exploded-view diagram of the impeller according to an embodiment of the invention;

FIG. **3** is a cross-sectional view along line A-A in FIG. **1**;

FIG. **4**A is a schematic diagram of a metal housing according to an embodiment of the invention;

FIG. **4**B is a top view of the metal housing according to an embodiment of the invention;

FIG. **5** is a schematic diagram of a shaft according to an embodiment of the invention;

FIG. **6** is a schematic diagram of a metal housing and a shaft according to another embodiment of the invention;

FIG. **7** is a schematic diagram of a metal housing and a shaft according to another embodiment of the invention; and

FIG. **8** is a schematic diagram of a metal housing according to another embodiment of the invention.

DETAILED DESCRIPTION OF INVENTION

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly

understood by one of ordinary skill in the art to which this invention belongs. It should be appreciated that each term, which is defined in a commonly used dictionary, should be interpreted as having a meaning conforming to the relative skills and the background or the context of the present disclosure, and should not be interpreted in an idealized or overly formal manner unless defined otherwise.

FIG. **1** is a schematic diagram of an impeller **10** according to an embodiment of the invention, and FIG. **2** is an exploded-view diagram of the impeller **10**. Referring to FIG. **1** and FIG. **2**, the impeller **10** primarily includes a metal housing **100**, a shaft **200**, and a plastic member **300**. The metal housing **100**, the shaft **200**, and the plastic member **300** can be affixed to each other. The impeller **10** can be pivotally connected to a driving module (such as a motor) via the shaft **200**, so as to rotate the impeller **10**.

The impeller **10** can be used in a fan system, which is applied to dissipate heat (for example, the fan system disposed in a personal computer, a notebook computer, or a server rack), ventilate (for example, the fan system disposed on a ventilation window), or pressurize (for example, the fan system disposed in a pump or a vacuum cleaner), but it is not limited thereto.

FIG. **3** is a cross-sectional view along line A-A in FIG. **1**, and FIGS. **4**A and **4**B are schematic diagrams of the metal housing **100**. Referring to FIGS. **2**-**4**B, the metal housing **100** includes a plate **110** and a lateral wall **120**. The lateral wall **120** is connected to the edge of the plate **110** and extended downwardly. Therefore, a cylindrical structure can be formed, and an accommodating space R can be constituted by the lateral wall **120** and the plate **110**. The plate **110** has a shaft mounting hole **111** communicating with the accommodating space R.

Specifically, a plurality of contact portions **113** can be formed on the inner surface of the shaft mounting hole **111**. The contact portions **113** are separated from each other, and each of the contact portions **113** has a contact point P. Furthermore, a virtual axis having the same distances away from all the contact points P can be defined as a main axis AX1 of the metal housing **100**. Preferably, the contact points P are rotational symmetrically arranged relative to the main axis AX1.

Referring to FIGS. **2**, **3**, and **5**, the shaft **200** passes through the shaft mounting hole **111** and is connected to the metal housing **100**. The shaft **200** can be divided into an upper section **210**, a middle section **220**, and a lower section **230** along a central axis **201** of the shaft **200**. When the shaft **200** passes through the shaft mounting hole **111** and is mounted on the metal housing **100**, the upper section **210** protrudes from the upper surface **114** of the plate **110**, the middle section **220** is accommodated in the shaft mounting hole **111**, and the lower section **230** protrudes from the lower surface **115** of the plate **110** and is accommodated in the accommodating space R.

When the shaft **200** passes through the shaft mounting hole **111** and is mounted on the metal housing **100**, the central axis **201** of the shaft **200** is substantially aligned with the main axis AX1 of the shat mounting hole **111**. In this embodiment, the distance between the main axis AX1 and each of the contact points P of the contact portions **113** is preferably less than the radius of the shaft **200**. Therefore, when the shaft **200** is mounted, the contact points P are closer to the shaft **200** than other portions of the inner surface of the shaft mounting hole **111**, and the contact points P can be in contact with the middle section **220** of the shaft **200**. When the contact points P are in contact with the middle section **220** of the shaft **200**, they may be deformed to clamp and affix the shift **200**. Owing to the contact portions **113** and the contact points P, the position of the shaft **200** relative to the metal housing **100** in the X-axis and the Y-axis can be affixed.

Preferably, the impeller **10** includes at least three contact portions **133** and contact points P to ensure that the position of the shaft **200** relative to the metal housing **100** in the X-axis and the Y-axis (in this embodiment, the impeller **10** includes four contact portions **133** and contact points P). Moreover, in this embodiment, the upper section **210** of the shaft **200** has a concave structure.

As shown in FIGS. **1**-**3**, the plastic member **300** covers the metal housing **100** and is in contact with the metal housing **100** and the shaft **200**. In detail, when the plastic member **300** is formed by overmolding, a portion of the plastic member **300** passes through the shaft mounting hole **111** and enters the accommodating space R. Therefore, the plastic member **300** is in contact with the middle section **220** of the shaft **200** and the inner surface of the shaft mounting hole **111**, and the position of the shaft **200** relative to the metal housing **100** in the Z-axis can be affixed.

In this embodiment, the plastic member **300** is also in contact with at least a portion of the upper section **210** of the shaft **200**, at least a portion of the lower section **230** of the shaft **200**, and the upper surface **114** or lower surface **115** of the plate **110**. Thus, the metal housing **100**, the shaft **200**, and the plastic member **300** can be affixed to each other steadily. In addition, when the plastic member **300** is attached on the concave structure of the upper section **210** of the shaft **200**, the metal housing **100**, the shaft **200**, and the plastic member **300** can be affixed to each other more steadily.

Furthermore, embossing texture can be formed on the inner surface of the shaft mounting hole **111**, the upper surface **114** of the plate **110**, the lower surface **115** of the plate **110**, or the shaft **200**, so as to increase the surface roughness of the aforementioned portions. When the plastic member **300** is in contact with the aforementioned members, the plastic member **300** can be in contact with embossing texture, so that the engaged strength between the plastic member **300** and the metal housing **100** can be further enhanced.

In this embodiment, each of the contact portions **113** include the same appearances and thicknesses, and the thicknesses of the contact portions **113** are less than that of the metal housing **100** at the periphery of the shaft mounting hole **111**. In some embodiment, the contact portions **113** include different lengths, widths, and/or thicknesses (for example, in FIG. **8**). In other words, the contact areas, the dimensions, and the shapes of the contact portions **113** can be different.

At the outer periphery of the plastic member **300**, a plurality of blades **301** are formed. At least one rotator magnet is disposed in the metal housing **100**. The rotator magnet and the driving module interact with each other, so as to rotate the blades **301**. When the driving module is accommodated in the accommodating space R, the metal housing **100** can reduce the interference of the radiated emission.

Besides the aforementioned advantages, the automated production of the impeller **10** can be achieved by using the plastic to directly affix the metal housing **100** and the shaft **200**.

The shaft mounting hole can include other appearance. Referring to FIG. **6**, in another embodiment of the invention, the shape of the opening of the shaft mounting hole **111**A is not circular, and at least one contact portion **113**A can be

formed on the inner surface of the shaft mounting hole **111**A. When the shaft **200** passes through the shaft mounting hole **111**A and is mounted on the metal housing **100**A, the shaft **200** is clamped by the contact point P" of the contact portion **113**A and the contact point P' of the inner surface of the shaft mounting hole **111**A. The contact point P" and the contact point P' is closer to the main axis AX1 of the metal housing **100**A than other portions of the shaft mounting hole **111**A.

When the shaft **200** passes through the shaft mounting hole **111**A and is mounted on the metal housing **100**A, the central axis **201** of the shaft **200** is substantially aligned with the main axis AX1 of the shaft mounting hole **111**A. In this embodiment, the distance between the contact point P" of the contact portion **113**A and the main axis AX1 is preferably slightly less than the radius of the shaft **200**. Thus, when the shaft **200** is mounted, the contact portion **113**A and/or the shaft mounting hole **111**A is slightly deformed, and the shaft **200** can be clamped and affixed.

The plastic member **300**A filled in the shaft mounting hole **111**A can be in contact with the middle section **220** of the shaft **200** and the inner surface of the shaft mounting hole **111**A, so as to affix the position of the shaft **200** relative to the metal housing **100**A in the Z-axis.

In this embodiment, the shape of the opening of the shaft mounting hole **111**A is oval, but it is not limited thereto. In some embodiments, the shape of the opening of the shaft mounting hole **111**A can be triangular, square, rectangular, pentagonal, hexagonal, or other polygonal.

Referring to FIG. **7**, in some embodiments, the shape of the opening of the shaft mounting hole **111**B is polygonal, and there is no contact portion formed on its inner surface. Specifically, the shape of the opening of the shaft mounting hole **111**B is a regular polygon. Therefore, the shaft **200** can be in contact with every side of the polygon, and the contact points P"" can be formed at the contact positions. The main axis AX1 of the shaft mounting hole **111**B passes through the center of the shaft mounting hole **111**B, and the has same distances away from each of the contact points P"". When the shaft **200** passes through the shaft mounting hole **111**B and is mounted on the metal housing **100**B, the central axis **201** of the shaft **200** is substantially aligned with the main axis AX1 of the shaft mounting hole **111**B. In this embodiment, the distances between the contact points P"" and the main axis AX1 are slightly less than the radius of the shaft **200**. Thus, when the shaft **200** is mounted, the contact points P"" are in contact with the middle section **220** of the shaft **200**, the shaft mounting hole **111**B is slightly deformed, and the shaft **200** can be clamped and affixed.

The plastic member **300**B filled in the shaft mounting hole **111**A can be in contact with the middle section **220** of the shaft **200** and the inner surface of the shaft mounting hole **111**B, so as to affix the position of the shaft **200** relative to the metal housing **100**B in the Z-axis.

In summary, an impeller is provided, including a metal housing, a shaft, and a plastic member. The metal housing has a shaft mounting hole. The inner surface of the shaft mounting hole includes three or more contact points, and the contact points are closer to the shaft than other portions of the inner surface of the shaft mounting hole. The shaft passes through the shaft mounting hole and is affixed by the contact points. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

An impeller is also provided, including a metal housing, a shaft, and a plastic member. A contact portion is formed on the inner surface of the shaft mounting hole. The shaft passes through the shaft mounting hole and is affixed by the contact portion. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

An impeller is further provided, including a metal housing, a shaft, and a plastic member. The metal housing has a shaft mounting hole. The opening of the shaft mounting hole is a polygonal opening. The shaft passes through the shaft mounting hole and is affixed by the shaft mounting hole. The metal housing divides the shaft into an upper section, a middle section, and a lower section. The plastic member passes through the shaft mounting hole and is in contact with the middle section.

Although some embodiments of the present disclosure and their advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the disclosure as defined by the appended claims. For example, it will be readily understood by those skilled in the art that many of the features, functions, processes, and materials described herein may be varied while remaining within the scope of the present disclosure. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, compositions of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present disclosure, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed, that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present disclosure. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps. Moreover, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

While the invention has been described by way of example and in terms of preferred embodiment, it should be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation to encompass all such modifications and similar arrangements.

What is claimed is:

1. An impeller, comprising:

a metal housing, having a shaft mounting hole;

a shaft, passing through the shaft mounting hole, wherein a portion of an inner surface of the shaft mounting hole is in contact with the shaft; and

a plastic member, connected to the shaft and a remaining portion of the inner surface of the shaft mounting hole that is not in contact with the shaft, wherein the plastic member comprises:

a disk portion, connected to the metal housing;

a plurality of blades, connected to the disk portion; and

a ring, wherein the blades are connected to each other via the ring and the disk portion.

2. The impeller as claimed in claim **1**, wherein the portion of an inner surface of the shaft mounting hole is in contact with the shaft in two or more separated contact points.

3. The impeller as claimed in claim 2, wherein the two or more separated contact points are formed on a plurality of contact portions of the metal housing, and the contact respective areas, the respective dimensions, or the respective shapes of the plurality of contact portions are different.

4. The impeller as claimed in claim 2, wherein the two or more separated contact points are formed on a plurality of contact portions of the metal housing, and the respective lengths, the respective widths, or the respective thicknesses of the plurality of contact portions are different.

5. The impeller as claimed in claim 1, wherein an embossing texture is formed on the shaft or the inner surface, and at least a portion of the embossing texture is in contact with the plastic member.

6. The impeller as claimed in claim 1, wherein the metal housing divides the shaft into an upper section, a middle section, and a lower section, and the plastic member is in contact with the middle section and extended to contact at least a portion of the upper section or a portion of the lower section.

7. The impeller as claimed in claim 1, wherein the metal housing has an upper surface and a lower surface opposite to the upper surface, and the plastic member is further in contact with the upper surface and the lower surface.

8. The impeller as claimed in claim 1, wherein a shape of an opening of the shaft mounting hole is polygonal.

9. The impeller as claimed in claim 1, wherein the ring is connected to tops of the blades.

10. An impeller, comprising:

a metal housing, having a shaft mounting hole and a contact portion;

a shaft, passing through the shaft mounting hole and affixed by the contact portion, wherein a portion of an inner surface of the shaft mounting hole is in contact with the shaft; and

a plastic member, connected to the shaft and a remaining portion of the inner surface of the shaft mounting hole that is not in contact with the shaft, wherein a thickness of the contact portion is less than an average thickness of the metal housing, and the plastic member comprises:

a disk portion, connected to the metal housing;

a plurality of blades, connected to the disk portion; and

a ring, wherein the blades are connected to each other via the ring and the disk portion.

11. The impeller as claimed in claim 10, wherein the metal housing has a plurality of separated contact portions, the shaft is affixed by the contact portions, and the contact areas, the dimensions, or the shapes of the contact portions are different.

12. The impeller as claimed in claim 10, wherein the metal housing has a plurality of separated contact portions, the shaft is affixed by the contact portions, and the lengths, the widths, or the thicknesses of the contact portions are different.

13. The impeller as claimed in claim 10, wherein a shape of an opening of the shaft mounting hole is polygonal.

14. The impeller as claimed in claim 10, wherein an embossing texture is formed on the shaft or the inner surface, and at least a portion of the embossing texture is in contact with the plastic member.

15. The impeller as claimed in claim 10, wherein the metal housing divides the shaft into an upper section, a middle section, and a lower section, and the plastic member is in contact with the middle section and extended to contact at least a portion of the upper section or a portion of the lower section.

16. The impeller as claimed in claim 10, wherein the metal housing has an upper surface and a lower surface opposite to the upper surface, and the plastic member is further in contact with the upper surface and the lower surface.

17. The impeller as claimed in claim 10, wherein the ring is connected to tops of the blades.

* * * * *